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(54) METHOD AND DEVICE FOR WASHING A CONTINUOUS FILTER WITH A HORIZONTAL FILTRATION SURFACE AND CELLS

(71) We, "SOCIÉTÉ DE PRAYON", a company organized under the laws of Belgium, of Prayon, Commune de Forêt, (Belgium), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The present invention relates to a method for washing a continuous filter with a horizontal filtration surface and cells, after the discharge of the filtration cake.

The said filter cells comprise pans of various shapes, depending on the type of filter, vacuum resistant and having a horizontal filtration surface comprised of a cloth and a support for such cloth. The cell further comprises a filtrate discharge piping or a filtrate outlet connected to a distributor whose function is to separate the different filtrates. At present, three types of filters of this kind are known: filters with tilting cells arranged in a circle around a central distributor, filters with a circular table wherein the different cells remain horizontal and are connected in a rigid manner so as to provide a continuous horizontal filtration surface in the shape of a circular ring arranged around a central distributor and, lastly, filters with rectangular cells sliding end to end on parallel rails in which case the distributor is of elongated shaped so as to extend parallel to the said slide rails and to be in contacting relationship with the bottom of each cell by means of a leak-proof sliding joint. Filters of this type have been illustrated and briefly described in "Revue Industrie Technik und Maschinenwelt Heft 1/1959".

The filtration of slurries and the washing of the cake thereof on such filters give rise, in certain cases, to considerable difficulty on account of the rapid formation of heavy scaling which is very adhesive and forms hard deposits on the cloths and in the pipe-runs of the filtration and washing liquids, and which necessitates frequent stoppages and expensive manual cleaning operations. This occurs, for instance, when filtering slurries containing, in the solid phase, hemihydrate calcium sulphate.

Up to the present, in order to overcome this disadvantage, such filters have been provided with means allowing the filters to be swilled out for dissolving the scale and the sediment formed on the filtration surfaces. Thus, in the case of filters with tilting cells, after having discharged the cake, the tilted cells are continuously washed by means of washing pipe-runs which deliver to the filter cloth large quantities of water not saturated with dissolved scaling substances, in the hope of dissolving by this known method the scale and sediment.

These means and this washing method are, however, inadequate in many cases and do nothing to clean the vacuum chamber (i.e. the interior filtration cells) or the lower face of the filter cloth.

The present invention seeks to overcome the said disadvantages and to offer a very simple method, probably already applied in other fields than that of filtration, but which as applied to the specific field of filtration provides surprisingly good and extremely efficient cleaning.

For that purpose, water jets of high kinetic energy and/or heavily turbulent water flows are used in order to cause a mechanical scouring of the scale or sediment and the taking away thereof.

The present invention also embraces a special washing by means of which it is possible to obtain an efficient cleansing of the inner face of the filtration cloth and of the interior portions of the cell extending beneath such cloth.

According to the invention, a method for washing a continuous filter having filtration surfaces mounted in cells, in which washing is carried out after the discharge of the filtration cake from the filtration surface, is characterised in that water jets of a pressure

f at least 1 kg/cm² are directed onto the filtration surface of each cell in order to cause a mechanical scouring of sediment and/or scale formed on the filtration surface in the course of filtration to remove such sediment and/or scale.

Advantageously, in the case of filters with tilting cells, the method according to the invention provides introducing additional washing liquid in the interior volume of said cells at least at the moment when the cell after having been tilted to a reversed position, is returning to the normal horizontal position following discharge of the cake and after or during the washing of the outside of the filtration surface whereby under gravity actuation the scouring effect of the water on the inside face of the filtration surface and on the support of the latter is enhanced.

The present invention also relates to a washing appliance for working the special method permitting to secure an efficient washing of the inside face of the filtration surface and of the parts of the cell positioned beneath such surface.

This appliance is characterised in that it comprises at least one washing pipe-run mounted in the volume provided inside each cell on the side of the inside face of the filtration surface.

Advantageously, in the case of tilting cells filters where the washing pipe-runs are stationary with reference to the cells, such pipe-runs are connected by flexible tubes to a distributor for washing liquid.

Other details and features of the invention will become apparent from the description, hereinafter given, by way of non-limiting example of one particular embodiment of the method according to the invention and of a special appliance for working a modified form of such method, with reference to the accompanying drawing, in which: —

Figure 1 is a diagrammatic perspective view, partially broken away, of a continuous horizontal filter with tilting cells.

Figure 2 is a plan view, on a larger scale, of a filter cell illustrated in Figure 1, the filtration cloth being withdrawn and the cell tilted.

Figure 3 is a sectional view along the line III—III of Figure 2.

In the three Figures, the same numerical references designate the same components.

The method according to the invention employs the scouring characteristics of a water jet to remove scale and other sediment from the filter faces and cells of a continuous filter and only to a negligable extent, uses the dissolving properties of water which has been, up to the present, been the main property employed in cleaning said filters.

In this connection it was noted, according to the invention, that washing with highly pressurized water, at a pressure of at least 1 kg/cm², and preferably from 2 to 15 kg/cm² pressure, allows the elimination in the majority of cases, of the scale which is formed, in the course of filtration, by the slurry being filtered. Such washing takes place for preference in the cycle of the operations carried out on the filter prior to supplying the slurry to the cells and after the ordinary washings of the cloths following the discharge of the cake.

The jets of water, having a large kinetic energy, are projected on the portions of the cells to be washed, in particular on to the filtration surfaces (or cloths), in such a manner as to mechanically remove i.e. by scouring, the scale which may have formed on the said portions.

It is very important to remove the washing water as and when it is projected in a jet in order to prevent a swamping of the surface being cleaned since if swamping does occur the efficiency of the cleaning and scouring is much reduced. Moreover, it is desirable for the cell to be fully drained of washing water prior to supplying the slurry in the following cycle.

These aims are advantageously achieved by applying a vacuum to an outlet of the cells thus causing a fast and heavily turbulent flow of the washing liquid as it is removed from the cells.

The washing, according to the invention, may be effected by means of pipe-runs provided with holes or provided with direct jet nozzle atomizers (so-called descaling nozzles), in order to provide a maximum kinetic energy of the massive jets which may be produced by such pipe-runs. The washing liquid passes successively through the cloth, the cell and the distributor and is withdrawn under vacuum by means of a vacuum pipe and, if need be, via an air-liquid separator connected to the vacuum source.

The fact that the predominant action of the washing liquid is a mechanical scouring and not a dissolution, as in the known washing methods, permits the recycling of substantially the total quantity of the washing liquid (after a possible settling of the solids content), so that the quantity of fresh water needed may be reduced to nearly zero. In the known methods of washing filters of the said type, water is used in a large quantity and with a heavy flow so as to encourage as much as possible the dissolution of the scale in this water. This manner of operating involves a substantial consumption of energy and requires the provision of important and costly plants. Moreover, in order to achieve a satisfactory efficiency of dissolving and, consequently, of washing the cells, the washing water employed has to contain a minimum of dissolved matter and this reduces the rate of possible recycling and causes a heavy consumption of fresh washing water.

It should als be noted that due to the high kinetic energy of the washing liquid fed to the cells and the acceleration to which it is subjected by the vacuum source, the filter cloth, the vacuum chamber, the flow pipes and the distributor are all subjected to the scouring effect of the heavily turbulent flow under the accelerating vacuum effect and accordingly are all kept clean.

The fact that the top face of the cloth and its support is struck by highly pressurized water jets having high kinetic energy assures a perfect cleaning of such top face and support.

In order to achieve an equivalent cleaning of the bottom face of the cloth and support as well as of all the portions of the cells positioned beneath such cloth (i.e. the vacuum chamber), according to the invention, washing liquid can be supplied directly to the space provided beneath the filtration cloth, after discharging the cake, so that this washing water may flow with an adequate kinetic energy along such bottom face of the cloth and the parts to be cleaned positioned beneath the latter without such energy being absorbed on passing through the cloth.

Depending on the position of the cell and on the kinetic energy inherent in the jets of water directed against one of the cloth faces, such water may eventually pass through the latter. In any case, the kinetic energy of the washing water having passed through the cloth is no longer sufficient by itself to achieve the mechanical action (scouring) necessary for a cleaning of the other face of the cloth.

This is why it is useful, according to a preferred feature of the invention, to provide for a double washing, i.e. a washing by jets of water striking directly the upper or outer face of the cloth and by means of jets of water striking directly the lower or inner face of such cloth as well as the parts positioned beneath the latter and to combine the whole thereof with an accelerating action induced by the vacuum source.

In the case of tilting cells filters, the inside of the cells is washed for preference following the discharge of the cake, at the time of washing the outer face of the tilted cell in the course of rotating the cell so as to be able to benefit from the effects of gravity to accelerate the inner washing water. This gravity enhancing effect enables the liquid fed to the interior of the cell to be supplied at a pressure, amounting from 0.2 to 1 kg/cm², while still achieving an adequate scouring effect on the scale which might have possibly formed.

The washing water is for preference admitted to the interior portion of the cell, beneath the cloth, when it is subjected to an upwards directed rotation at the moment when it straightens out, so that the liquid may, under the action of gravity, be subject to an accelerated flow in the volume provided beneath the cloth over the whole of the inner of lower face of the cloth.

It is preferable to carry out preventive washings in order to remove solid matters deposited prior to scaling. Such preventive washing may be achieved by carrying it out in a permanent manner at each filtration cycle prior to the supply of the slurry.

In order to illustrate further the method according to the invention, a description is hereinafter given by way of non limiting example with reference to the aforesaid accompanying drawings.

The filter, illustrated in Figure 1, is a so-called "horizontal filtration surface with tilting cells" filter. This comprises a series of identical cells 1 having substantially the aspect of a sector and moving along a circumference of a circle in the direction of the arrows 13 around a central stationary vacuum distributor 12 provided at the centre of such circumference.

Such cells 1 move in a continuous manner along such circumference.

A series of successive operations take place for each of the cells 1 in the course of a complete movement through 360° around the distributor 12.

At a well defined point of the circuit of the cells 1, the slurry is poured onto a filter cloth 2 in the cells. This point has been diagrammatically shown by a slurry supply tube bearing the reference 14. After removal of the filtrate from the cell, the filtration cake 16 formed on the filter cloth is subjected to two successive counterflow washings, as shown diagrammatically by the arrows 15.

Subsequently, the cells are tilted so as to remove the filtration cake 16. This operation is then followed by a new washing with water of the filter cloth (while the cell remains in its reversed position) and is illustrated at 20.

All these operations, so far described, are part of the conventional filtration technique by means of a filter with a horizontal surface and tilting cells.

According to the invention, this last washing is followed, or accompanied, by a special washing of the inner face of the filtration cloth and of the inner portions of the cell by directly supplying washing water to the interior volume of the said cell beneath the filtration cloth for at least the time needed during which the cell straightens out to return to its normal horizontal position.

This washing, in the illustrated embodiment is carried out by means of a double washing pipe-run 8 mounted in the space provided beneath the filtration cloth 2.

Figures 2 and 3 show in detail the construction of a cell 1 comprising such pipe-runs 8.

As already described above, the cell 1

comprises a pan, generally of stainless steel, wherein is positioned the filtration cloth 2 resting on a support 3 comprising, for instance, a grid or a special rubber carpet with projecting portions supporting the cloth. This support allows the provision, beneath the bottom face of the cloth, of a space facilitating the flow of the filtrates and of the washing waters.

The support 3 is carried in turn on a series of cross members 4 extending from the bottom 5 of the cell within a space 10 provided beneath the cloth 2. The bottom 5 slopes towards a central tube 6 extending parallel to such bottom and integral with the latter, this tube recovering the filtrates and the washing waters to direct them by means of flexible tubes 17 (see Figure 1) to the central distributor 12. The tube 6 is carried in bearings 7 and functions, therefore, simultaneously as a rotation shaft around which the cell 1 swivels on tilting.

Each pipe-run 8 is connected by a flexible tube 11 to a special water distributor 18 mounted above the main vacuum distributor 12, the distributor 18 admitting the water to the pipe-runs 8 at the needed pressure and at the right moment, i.e. after the discharge of the cake and after or during the washing, known per se, of the cloth of the reversed cell. This water is projected by the pipe-run 8 against the inner face of the cloth 2, the support 3, the cross members 4 and the bottom 5 of the cells 1.

When the cell is straightened out, it passes beneath a pipe-run 19 supplied with water at a pressure of at least 1 kg/cm² and preferably from 2 to 15 kg/cm². This pipe-run 19 which extends over the whole length of such cell, directs jets of water of high kinetic energy on to the outer and again upper surface of the cloth, so that as these jets strike directly the cloth, they cause a mechanical scouring of the scale left on the cloth so as to remove it and to take it away mechanically with the stream of water through the cloth under the effect of the vacuum established by means of the distributor 12 to which the tube 6 is connected. It should be noted that the scale is finely crushed by the action of these jets of water so that it passes easily through the cloth.

The distributor 12, known *per se* and therefore not represented in detail in the drawings, enables a vacuum to be maintained beneath the filtration cloth in the course of the actual filtration operation immediately following the supply of the slurry at the point 14, in order to obtain a substantially dry cake prior to the first washing with water and intermediate different successive washings, as well as to dry the cloth after the last washing thereof prior to supplying the slurry to the point 14. Moreover, the distributor 12 makes it possible to supply, when the cells are reversed, air to the tube 6 in order to effect an outward bulging of the cloth and to facilitate thereby the discharge of the cake and the washing of the cloth at the point 20.

It should be understood, that the invention is not limited to the details of the described embodiment and that many changes may be introduced therein without departing from the scope of the following claims.

WHAT WE CLAIM IS:—

1. A method for washing a continuous filter having filtration surfaces mounted in cells, washing being carried out after the discharge of the filtration cake from the filtration surface, wherein water jets of a pressure of at least 1 kg/cm² are directed onto the filtration surface of each cell in order to cause a mechanical scouring of sediment and/or scale formed on the filtration surface in the course of filtration to remove such sediment and/or scale.

2. A method as claimed in claim 1, herein the water jets strike the filtration surfaces with a pressure of from 2 to 15 kg/cm².

3. A method as claimed in claim 1 or 2, wherein in the case of a filter with tilting cells the scouring jet is directed on the outwardly facing filtration surface of each cell following the discharge of the cake and the washing, known *per se*, of the filtration surface after the cell has been turned again to its filtration position and prior to the next supply of slurry to be filtered, the washing water thus passing through the cloth, into the interior of the cell and a distributor connected thereto.

4. A method as claimed in any preceding claim, wherein vacuum is applied to the interior of the cell when the water jet is projected on to the filtration surface.

5. A method as claimed in claim 4, wherein the rate of flow of water through the filtration surface and its removal from the interior of the cell gives rise to a cleansing action on the interior surfaces of the cell.

6. A method as claimed in any preceding claim, wherein the washing liquid is recycled at least in part possibly after having been subjected to a settling period.

7. A method as claimed in any preceding claim, wherein washing water is directly forced inside the cell into the volume provided beneath the filtration surface following the discharge of the filtration cake, in order to wash the inner face of such surface and the inner portions of the cell.

8. A method as claimed in claim 7, wherein, in the case of a filter with tilting cells, the said washing liquid is introduced into the said cell volume at the moment when the cell, after having been tilted to a reversed position, is returning to the normal horizontal filtration position following discharge of the cake and after or during the washing

of the outside of the filtration surface whereby under gravity actuation the scouring effect of the water on the inside face of the filtration surface and on the support of the latter is enhanced.

9. A method as claimed in either of claims 7 or 8, wherein the washing liquid is introduced in the space beneath the filtration surface by means of jets of which at least a part is directed immediately towards the inside face of the filtration surface.

10. A washing appliance for a continuous filter with a horizontal filtration surface and cells for working the method as claimed in any of claims 7 to 9, comprising at least one washing pipe-run mounted in the volume provided inside each cell on the side of the inside face of the filtration surface.

11. A washing appliance as claimed in claim 10, wherein, in the case of tilting cells, the washing pipe-runs being stationary with reference to the cells, such pipe-runs are connected by flexible tubes to a distributor for washing liquid.

12. A method for washing with water a continuous filter, substantially as hereinabove described.

13. A washing appliance for a continuous filter, substantially as hereinabove described with reference to, and as illustrated in, the accompanying drawing.

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1376383 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG.1.

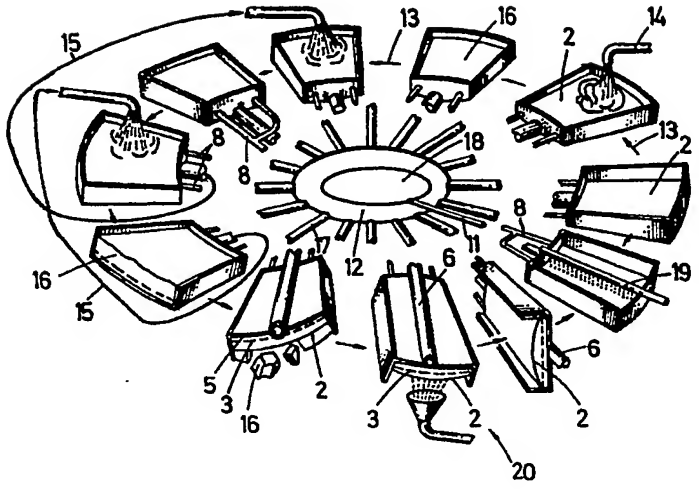

FIG.2.

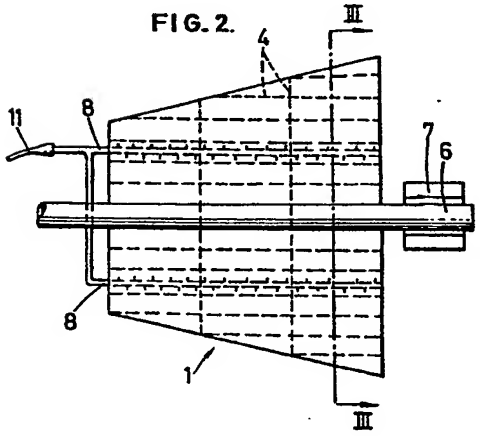

FIG.3.